NOTICE

All drawings located at the end of the document.

FINAL
TECHNICAL MEMORANDUM No.2

ADDENDUM TO FINAL PHASE I RFI/RI WORK PLAN

Surface Geophysical Surveys

Rocky Flats Plant
Woman Creek Priority Drainage

(Operable Unit No. 5)

Prepared for:

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1.0 INTRODUCTION

This Technical Memorandum (TM) No. 2 was specified under the Final Phase I RFI/RI Work Plan (U.S. Department of Energy, [DOE], 1992a). The Woman Creek Priority Drainage Area (Operable Unit 5 [OU5]) generally lies south of the controlled area, extends along part of the Woman Creek Drainage and ends near the east-west drainage divide north of Smart Ditch at the Rocky Flats Plant (RFP).

1.1 BACKGROUND AND HISTORY

Seven of a total of the ten Individual Hazardous Substance Sites (IHSS) located within the Woman Creek Priority Drainage Area, are the subject of this Technical Memorandum No. 2. The areas of the Original Landfill (IHSS 115), Ash Pits (IHSS 133.1-133.4), Incinerator (IHSS 133.5), and Concrete Wash Pad (IHSS 133.6) are being investigated as part of the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) within part of OU5 at RFP. The three IHSSs not included are: 142.10 - C1 Pond, 142.11 - C2 pond, and 209-Surface Disturbance. The Final Phase I RFI/RI Work Plan (DOE, 1992a) describes the environmental pathways of potential contaminants and preliminary site characterization, and recommends work to be performed for the Phase I investigations in the Woman Creek Drainage. An overview of the RFP and Woman Creek is shown in Figure 1.1. OU5 includes the Woman Creek Priority Drainage and is located south of the west site access road within the RFP buffer zone as shown in Figure 1.2.

The seven IHSSs, all located on the south-facing alluvial slopes within the buffer zone in the western part of OU5, have been recognized as previously active site features at RFP. Presently

these IHSSs are inactive and have not supported plant functions for a number of years. Vertical aerial photographs (Environmental Protection Agency [EPA], 1988) and oblique aerial photographs furnished through EG&G have served to chronologically document the progressive surface usage of these south-facing alluvial slopes located between the south fence of the RFP controlled area and Woman Creek in the western part of OU5.

1.1.1 IHSS 115 - Original Landfill

Figure 1.2 illustrates the location of the Original Landfill (IHSS 115) within the OU5 area. The extension to this IHSS occupies the area enclosed south of the South Interceptor Ditch (SID). The landfill and its extensions cover approximately 7.5 acres as shown in Figure 1.3. The facility was operated from 1952 through 1968 and was used to dispose of general waste at RFP. A liner was not installed at the landfill.

Rockwell International (1988) estimated that 2 million cubic feet of wastes are buried at IHSS 115. These wastes include solvents, paints, oil, pesticides, and cleaners. Beryllium and/or uranium wastes may have been deposited. Early in the history of site disposal, graphite was believed the initial waste. Ash containing 20 kilograms of depleted uranium is reported to have been buried at the facility. An evaporation/settling pond, used for backflushing sand filters from the Building 124 water treatment facility, was also present at the landfill. Vegetation has re-established, obscuring the limits of the Original Landfill and the other landfill materials in the southern extension of IHSS 115. Wastes observed during a July 8, 1992 site walkover included metal lathe cuttings, plumbing parts, and flattened steel drums. Two 3-foot-diameter metal outfall pipes are present near the northern edge of the Original Landfill.

In 1980, the SID was constructed to intercept precipitation runoff from the landfill and plant site in order to prevent the surface flow from reaching Woman Creek, located approximately 400 to

500 feet downslope to the south. This structure was intended to provide a surface water diversion and convey any contaminants to Pond C-2 for water treatment.

The immediate vicinity and area of IHSS 115 is transected west to east by overhead, surface, and underground utility service lines and graveled roads. These features are shown in Figure 1.4 and include, from the fence at the north down to Woman Creek on the south, a railroad track and siding, a subsurface 6-inch natural gas line, the chain link fence of the controlled zone perimeter road, the SID, a utility line service road, a subsurface 6-inch natural gas line, double wood poles carrying overhead 13.8 kilovolt electric service, several shallow wells, and an abandoned subsurface natural gas line (8-inch-diameter). Construction of the utility line service road and the SID across the toe of the Original Landfill resulted in wastes being relocated farther to the south toward Woman Creek.

1.1.2 IHSS 133.1 - 133.4 - Ash Pits

Information about these IHSSs is limited and based upon information provided in the OU5 Work Plan (DOE, 1992a) and Historical Release Reports (HRR) (DOE, 1992b). Ash generated from incinerator residues was deposited in four ash pits, IHSSs 133.1 through 133.4, shown in Figure 1.2. These pits are reported to be approximately 12 by 150 feet in area and 10 feet in depth with 3 feet of cover; exact dimensions however are unknown. After closure of the incinerator in 1968, the Ash Pits were covered with fill of unknown type. Presently grasses have revegetated the sites obscuring these wastes.

The IHSS 133.1-133.6 area is also transected by an electric utility line and underground pipe lines. Figure 1.4 shows the approximate locations of these IHSSs with respect to the infrastructure at this part of RFP.

1.1.3 IHSS 133.5 - Incinerator

Information about this IHSS is limited and based primarily upon information provided in the OU5 Work Plan (DOE, 1992a) and HRR (DOE, 1992b). This IHSS covers approximately 4,000 square feet and is shown in Figure 1.2. Combustible wastes had been collected in dumpsters from various sites at RFP then trucked and discharged to the incinerator input. The materials were then ignited with no augmentive fuel or air supply (Dean Burton, EG&G, telephone conversation, July 21, 1992). Regular operations of the incinerator were between the 1950s and 1968. Wastes, containing an estimated 100 grams of depleted uranium, were reported to have been burned in the incinerator prior to its removal. Ash from the incinerator was disposed of in the four Ash Pits, but the contingency exists for ash also to have been deposited at the Concrete Wash Pad (IHSS 133.6) and into the Woman Creek drainage. The Incinerator was removed by 1971 and revegetation began.

1.1.4 IHSS 133.6 - Concrete Wash Pad

Very little data is known about this IHSS and the following information is based upon the Final Phase I RFI/RI Work Plan (DOE, 1992a) and HRR (DOE, 1992b). This facility covers approximately 33,000 square feet and is located within 25 feet of Woman Creek as shown in Figure 1.2. It is inferred that this area was used to dispose of uncured concrete delivered for the construction of RFP facilities. The concrete delivery trucks were probably washed at this site also.

1.2 PURPOSE AND SCOPE

The purpose of this Technical Memorandum is to: 1) describe and detail the ground surface magnetic and electromagnetic geophysical survey approaches specified for IHSS 115 and, 2) consider the use of these same geophysical approaches to delineate the extent of subsurface

wastes for contingent implementation at IHSSs 133.1 through 133.6. Under the Final Phase I RFI/RI Work Plan (DOE, 1992a) all of the IHSSs of the 133 group will be measured by EG&G for *in-situ* radiation using the High-Purity Germanium (HPGe) gamma detector. The contingent implementation of surface geophysical surveys will be initiated based upon the results of the aerial photography review and the *in-situ* HPGe gamma radiation survey.

The purposes of the aerial photograph review were to: 1) determine if the mapped IHSSs locations and areas shown on Figures 2-2 and 2-6 of the Final Phase I RFI/RI Work Plan (DOE, 1992a) conform to the surface disturbances as identified on vertical aerial photographs taken from 1953 through 1988, and 2) identify other prominent features including disturbed ground, mounds, trenches, or depressions not identified in the Phase I RFI/RI Work Plan, but that should be specifically considered in the electromagnetic and magnetic geophysical surveys of these areas.

The aerial photographs used for this review were provided by EG&G and were taken from the AERIAL PHOTOGRAPHIC ANALYSIS COMPARISON REPORT, prepared for the DOE and the U.S. Environmental Protection Agency (EPA) by the EPA Environmental Monitoring Systems Laboratory in 1988 (EPA, 1988). These vertical photographs were taken in the years 1953, 1955, 1964, 1971, 1978, 1980, 1983, 1986, and 1988. Although significant time gaps do occur between 1955 to 1964, 1964 to 1969, and 1971 to 1978, most of the site changes that occurred during these times appear to reflect expanded facility operations as expected (i.e., enlargement of the IHSS 115 landfill area). Observed suspect features identified on any photograph that were not included in a delineated IHSS or any pronounced discrepancies found in the location of any IHSS are shown in the enclosed figures and referenced within this text. Other oblique aerial photographs from the RFP archives also served to provide documentation of surface disturbances and development in the IHSS areas.

The purpose of the HPGe gamma radiation survey will be to identify radioactive anomalies occurring in the area of geophysical investigation. It is unlikely that this radiation survey can

fully delineate covered features (i.e. Ash Pits) because of the shielding effect of the cover material over waste materials. Furthermore, in order to be detectable, the ash would have to have contained anomalously radioactive waste components when deposited at a disposal site. Consequently, the electromagnetic and magnetic surveys should augment the HPGe survey data for use in delineation and evaluation of the individual IHSSs. An additional site walkover, for the express purpose of ground checking indicated disturbed sites identified on aerial photographs, is planned prior to conducting the surveys. This information will also be essential in the locating and permitting of future bore holes in the IHSS 133 areas.

Following the implementation and analysis of these surveys, the IHSS areas will be sampled and analyzed for contaminants in surface soil solids, soil gases, surface water, and groundwater as detailed in the Final Phase I RFI/RI Work Plan and Technical Memorandum Nos. 1, 3, 4, 5, 7, 8, and 9 (DOE 1992c, d, e, f, g, h, and i). The surface geophysical surveys will follow or be concurrent with the *in-situ* gamma radiation survey. These two specified field screening programs should serve to provide delineation of the aerial extent of the Original Landfill at IHSS 115 and the location of trenches and covered wastes associated with Incinerator/Ash waste burial activities in the IHSS 133 group. Other surface disturbances within these IHSSs will also be geophysically characterized. Presently cover materials, vegetation, and incomplete historical documentation complicate the nature, location, and description of wastes previously deposited in the IHSS areas. The geophysical surveys will allow succeeding programs in these two IHSSs to more effectively select the location of samples for: water (TM1), soil (TM3), soil gases (TM4), geologic and anthropogenic materials (TM7), and ground water (TMs 8 and 9) as specified in the Final Phase I Investigation Tables 7-1 and 7-2 in the DOE 1992a document.

2.0 REVIEW OF EXISTING DATA

2.1 IHSS 115

2.1.1 Geology

The surface geology of the western part of the Woman Creek Priority Drainage Area is shown in Figure 2.1 (Figure 1-5, DOE, 1992a). The surface geology part of this figure, illustrates that essentially the entire area is covered by Quaternary alluvium or colluvium, with only isolated exposures of the Cretaceous Arapahoe Formation.

Geologic cross sections (Figure 2.2) show the underlying materials directly beneath IHSS 115, the Original Landfill and the southern extension. These cross sections indicate that the facility was developed on Rocky Flats Alluvium and younger, thin colluvial sediments. These thinner surficial geologic materials are relatively permeable compared to thicker, underlying Arapahoe Formation claystone. Bore hole 426-92 was recently drilled, geologically logged, and geophysically logged for bore hole electrical properties. Bore hole logging data show that upon entering the Arapahoe Formation, all recovered geologic materials and unrecovered zones (interpreted from electric logs) indicate only claystone lithology is present. Landfill cover is locally nil to approximately 2 feet in thickness and is composed of local clay and gravel materials. Some waste materials were observed protruding through the breached cover material.

2.1.2 Aerial Photographs

The review of aerial photographs of IHSS 115, the Original Landfill and extensions, indicated very minor differences in the overall configuration of the primary landfill area. The 1955 aerial photograph (Figure 2.3) shows that a berm was in place on the east side of the main landfill and that the existing pond, shown on Figure 2.4, had been enlarged or reworked and was located

farther to the south than previously shown in the OU5 Work Plan (Figure 2-2). The 1969 photograph indicated a pit or trench existed further west of the western end of the delineated landfill. This feature was not identified on the map (DOE, 1992a) of the IHSS 115 area. In 1971, a berm was identified just to the south of the west area of the landfill and is visible on the 1971 photograph shown in Figure 2.5. Subsequent photographs indicated that the berms identified above were eventually covered and that the landfill or disturbed area extended to the south at least as far as shown on Figure 2.4. Eventually the pond was completely refilled or reduced in size. The photographs also indicate that the surface disturbance, shown to the east of the landfill, and a previously-unidentified area to the east of the road had contained rubble piles of unknown origin. The SID, shown on the 1980 photograph (Figure 2.6), bisected the southern extension of the landfill, apparently breached the south end of the former pond, and came within 20 to 40 feet of the berm located to the south of the west area.

The surface geophysical survey area as originally planned (DOE, 1992a)and shown on Figure 1.4 will adequately cover IHSS 115 Figure 1.4. However, the survey should be extended approximately 250 feet further to the east to cover the additional surface disturbance area identified on the 1988 photograph. The extended area is also shown on Figure 2.4.

The 1969 indicated pit, located west of the western end of the delineated landfill area, should be identified on the ground prior to conducting the surveys to ensure that data will be acquired over this site.

2.1.3 Gamma Radiation Survey

During the months of August, October, and November, in 1990, an *in-situ* radiological survey of IHSS 115 was completed using the HPGe gamma detector and reported in the Final Phase I RFI/RI Work Plan (DOE, 1992a). This investigation found that radiation in the soil was contributed from potassium, uranium, and thorium. Radium and cesium were also measured

indirectly from daughter isotopes. Except for three anomalous concentrations of U^{238}, the other radionuclides appeared to be within naturally occurring geologic concentrations (DOE, 1992a). Figure 1.3 taken from that report (Figure 7.1), indicates the anomalous isoconcentration contours for U^{238} at three locations, two at the Original Landfill and one just southwest of IHSS 115.

The HPGe radiation survey completed at the IHSS 115 area also measured the radioisotope of cesium - Cs^{137}. This radionuclide has been recognized as a world-wide isotope of cesium attributed to nuclear weapons testing fallout and present on the ground. Typical values recorded over undisturbed ground range from 0.4 to 0.6 pCi/g peripheral to IHSS 115. However, where ground surfaces have been disturbed, such as by excavation or new soil cover Cs^{137} values have been recorded to be lowered by 60 to 80 percent at the Original Landfill on IHSS 115 (Ron Reiman, EG&G, personal communication, September 28, 1992). Therefore, areas covered by new soil, such as the Ash Pits, may possibly be discernible by negative cesium anomalies.

2.2 IHSS 133.1 THROUGH 133.6

2.2.1 Aerial Photographs

The review of the photographic coverage of IHSSs 133.1 through 133.6 indicates that 133.1 and 133.3 are apparently mislocated on Figure 2-6 of the Final Phase I RFI/RI Work Plan (DOE, 1992a), and that other suspect features exist that should be investigated during the proposed geophysical surveys.

IHSSs 133.1 and 133.3 are clearly defined on an oblique aerial photograph taken June 6, 1969 (Figure 2.7) and are located approximately as shown on Figure 2.8. In addition, the pit that comprises IHSS 133.3 can be identified on a 1964 aerial photograph and scaled to the map at a

location that is in agreement with the location shown on the 1969 oblique photograph (Figure 2.7).

Other features that should be identified on the ground, either by surface expression or from scaled locations from the vertical aerial photographs (EPA, 1988), include: the trench to the south of the 133.5 incinerator site (identified on the 1964 photograph); the ash dump to the north of the incinerator (identified on the 1988 photograph); the indicated pits or trenches to the west of 133.6 (1955 photograph); and the ash dump and possible pit to the north of the above site (1969 photograph). A north-south ash pile extending into IHSS 133.1 was also identified on the 1964 photograph, but could not be seen on later photographs. This site should also be located on the ground prior to conducting the electromagnetic and magnetic geophysical surveys.

Two areas of disturbed ground were also located in 1955 and 1969 photographs. These are located to the west of the main access road to the RFP and to the west of the IHSS 133 area. Subsequent photographs of these areas indicate no further disturbance. These areas were probably related to road construction and do not warrant further investigation.

2.2.2 Gamma Radiation Survey

The HPGe *in-situ* gamma radiation survey will also precede the surface geophysical survey in the IHSS 133 area as sequenced in the Final Phase I RFI/RI Work Plan (DOE, 1992a).

3.0 SURFACE GEOPHYSICAL METHODS

The use of non-invasive surface geophysical procedures at OU5 will permit the field geophysicists operating portable instruments to: 1) measure deviations from the normal planetary magnetic field, and 2) measure the electromagnetic response of the soil, water, and anthropogenic materials present below ground when induced by artificial electromagnetic fields. These methods offer the possibility of determining the location of geophysical anomalies, thereby inferring disturbances to natural geologic materials, ionic contaminant plumes in groundwater, and buried metallic objects.

These magnetic and electromagnetic geophysical survey methods have been selected to assist with the location and definition of filled trenches and limits of buried wastes after completion of the HPGe radiation survey within the western part of OU5.

3.1 MAGNETIC METHODS

This geophysical method measures the intensity of the local magnetic field. The local magnetic field is a combination of the local planetary magnetic strength and that component contributed by adjacent ferrous objects. Ferrous objects, containing iron, nickel, and cobalt, could arise from deposited wastes containing these metals and metal alloys. Locally-interfering effects also need to be considered (Van Blaircom, 1980), such as alternating current power sources, steel fencing, railroad rails, and underground pipelines.

3.2 ELECTROMAGNETIC METHODS

This geophysical method measures the electric current conductive properties of geologic materials, aquifers, and subsurface metallic objects. A conductivity contrast may be detected where artificial materials (ash or ionic solutes) are located within a trench in native materials

(soils). If aquifers or contained contaminants show contrasts exceeding 1,000 parts per million dissolved constituents, a contrast may be detected indicating a contaminant plume. By using and analyzing only certain parts of the artificially-induced return electromagnetic component, discrete highly-conductive subsurface materials may be detected, such as metallic objects of significant size within discernible burial depths.

4.0 GEOPHYSICAL SURVEYS FOR THE WESTERN PART OF THE WOMAN CREEK PRIORITY DRAINAGE AREA (OU5)

The Interagency Agreement (IAG, 1989) is the guiding document at RFP for prioritizing and scheduling work plans and their implementation of site assessments. That document describes work tasks to be performed at every IHSS in each respective operable unit at the plant.

For the IHSSs in the western part of the Woman Creek Priority Drainage Area (OU5), the IAG had not allocated a magnetic or electromagnetic surface geophysical survey. As the OU5 Work Plan evolved, modifications (additions) were designed that would allow for a more thorough qualification of the IHSSs by using geophysical methods (DOE, 1992a).

The work plan for the Woman Creek Priority Drainage Area (DOE, 1992a) specified an aerial photograph review. Review of 13 vertical aerial photographs of the RFP (EPA, 1988) over the period of 1953 to 1988 and 23 other oblique aerial photographs was accomplished. Figure 2.7, an oblique photograph taken June 5, 1969 is included because it documents the locations of some IHSSs in the 133 group and shows the western part of IHSS 115 (EG&G Photo No. 13677-06).

Results from the review of available photographic coverage of the IHSS 133 group indicate that:

1. Mapped IHSS locations have partial correlation to photographed ground features.
2. Photographic location of certain IHSSs of the 133 group do not coincide with mapped locations or boundaries.
3. Disturbed ground consisting of undocumented trenches, earthen piles, and other unmapped materials was indicated during the selective historical photographic review.

Two additional lines of information merit consideration of the value of surface geophysical surveys. First, based upon site utility maps the location of three natural gas pipelines are shown in Figure 1.4. Underground utility lines will require location prior to invasive well drilling in the IHSS 133 area. Each surface geophysical methods should be useful in preliminary location

of buried pipelines. Second, soil covering wastes in the IHSS 133 area could render radioactive detection impractical. Geophysical survey methods may help identify areas of metal waste indicative of trench perimeters. These five indications support the recommendation that both magnetic and electromagnetic geophysical surveys be conducted over all subject IHSS's in the western part of OU5.

4.1 GEOPHYSICAL SURVEY PROCEDURES AND GRID LOCATIONS

4.1.1 Field Instrumentation, Equipment, and Operations

All field instrumentation equipment and operations will conform to the procedures and requirements set forth in GT.18, Rev.2 SURFACE GEOPHYSICAL SURVEYS in EMD OPERATING PROCEDURES MANUAL No. 5-21000-OPS-GT, VOLUME III: Geotechnical, EG&G, 1992. Section 5.1 of that standard operating procedure specifically addresses the instrumentation, equipment, and field procedures to be utilized when conducting an electromagnetic surveys at RFP. The operations to be conducted at OU5 will also include a magnetic survey for which procedures are not covered in GT.18. A Document Change Notice (DCN) No. 5-21000-OPS-GT.18 has been approved which addresses magnetic survey design, procedures. This DCN is approved through September 17, 1993 only for applicable investigations within OU5; the DCN describing magnetic survey procedures for only the area of OU5 is given in Appendix 1.

Both geophysical surveys are non-invasive and use portable instruments. Each survey will be run on the same grid and station layout. The surveys are compatible in that one will not interfere with the other, and will require only nominal distance separation to prevent interference.
The survey locations, instrumentation, and field procedures that apply to OU5 are discussed in sections 4.1.2 through 4.3.2 of this report.

4.1.2 Geophysical Survey Location in IHSS 115 Area

The geophysical survey as originally proposed for IHSS 115 would cover a rectangular area of approximately 600 by 1700 feet and is shown in Figure 1.4. (The northern boundary of the geophysical survey has been moved southerly 25 feet to avoid the chain link fence at the buffer zone perimeter. Concurrently, the southern boundary has been extended 65 feet southerly to include all of IHSS 115, provide more coverage over the gamma anomaly found southwest of the landfill, and provide delineation of the 8-inch gas line). As a result of the aerial photograph review, the area will also be extended 250 feet to the east to cover the additional rubble piles identified on the 1988 aerial photograph (Figure 2.4). The extended boundary is also indicated in Figure 1.4. A baseline parallel to and located at approximately N747,700 feet will be land surveyed and marked with flagged stakes every 25 feet across the geophysical traverse area. The Colorado State plane coordinates of this area are enclosed by the following lines:

North by N748,090 feet,
South by N747,490 feet,
West by E2,080,850 feet, and
East by E2,082,800 feet.

Within this rectangular area the ground geophysical survey will use grid-traverse lines running north to south, spaced 25 feet apart.

4.1.3 Geophysical Survey Location in IHSS 133 Area

For geophysical surveys in the IHSS 133 Area, a trapezoidal area will be evaluated as shown in Figure 1.4. (The survey area shown in the Final Phase I Woman Creek Priority Drainage Area (OU5) Work Plan [Figure 7-2, DOE, 1992a] has been reduced along the northern side because of anticipated geophysical interference by the chain link fence at the buffer zone perimeter and the Southern Pacific Railroad track which serves RFP). A baseline parallel to and located

approximately at N747,600 feet (Colorado State plane coordinate) within this trapezoidal area will be land surveyed. This baseline will be marked by visible flagged stakes along its entirety each 12 1/2 feet. The coordinates of the corners defining the trapezoidal area are as follows:

SW Corner - N747,220	E2,078,230
SE Corner - N747,220	E2,080,850
NE Corner - N748,100	E2,080,850
NW Corner - N747,620	E2,078,230

Within this area the ground geophysical survey will use grid-traverse lines running north to south and spaced 12 1/2 feet apart. The geophysical traverses will be terminated where the active channel of Woman Creek is encountered.

At the IHSS 133 group, the pit and trench facilities are shallow, sizeable geophysical targets. Detection of these targets will rely primarily upon conductivity contrasts between contained artificial wastes and enclosing natural geologic materials. The intensity of contrast in conductivity is uncertain because of unknown ionic concentrations in soil and fill materials. The secondary target will be incombustible metallic and ferromagnetic material from the incinerator waste. The volume and size of ferromagnetic and metallic wastes are potentially smaller in this area than the landfill. As a consequence, the geophysical anomaly is expected to be less pronounced than the anomaly developed by wastes contained in the Original Landfill.

Additionally, the convergence of interfering utility lines, in the western part of OU5, would limit detection of objects at the 25-foot grid-traverse spacing originally specified in the OU5 Work Plan (DOE, 1992a). Because of the anticipated utility line interference and the smaller geophysical response from the conductive and ferromagnetic wastes, the geophysical survey at the IHSS 133 group area will be performed using a grid-traverse spacing on 12 1/2-foot centers.

4.2 GEOPHYSICAL INSTRUMENTATION

4.2.1 Magnetometer Equipment

The magnetometers to be used will be Scintrex/EDA Omni or equivalent. The fixed, base-station proton precession magnetometer will be used to record diurnal planetary magnetic variation. The area-wide survey will be conducted using the grid-roving, proton precession magnetometer. The grid-roving instrument has two total magnetic field sensors 19.5 inches apart and is capable of measuring vertical magnetic gradient using the field strength differential measurement at each sensor. The upper sensor will be located at 115 inches above the ground at IHSS 115. The method of measuring the reproducibility of the grid-roving magnetometer is specified in Section 4.3.1. Prior to starting the survey at the IHSS 133 group area, the height of the sensors will be optimized by performing the preliminary field procedure sequence specified in Section 4.3.2. The Scintrex/EDA Omni magnetometer has the capability to detect a 55-gallon steel drum buried three feet below surface (a drum generates a magnetic anomaly typically less than 10 feet in radius). For larger ferromagnetic objects, the effective depth of detection is greater, provided a significant anomalous surface magnetic field is available to the roving magnetometer. Data from each magnetometer will be recorded in solid state data loggers and downloaded daily to computer hard drive and disks for storage and retrieval. A hard copy of data will also be retained.

4.2.2 Electromagnetic Equipment

The electromagnetic survey will use a Geonics EM-31 capable of operating in the vertical and horizontal dipole modes to measure and record ground conductivity (quadrature phase component) and the presence of shallow metallic conductors (in-phase component). The vertical mode operation uses the transmitter coil in the horizontal plane and induces a vertical magnetic field into the ground. Depth of penetration is 6 meters below the coils which will be carried 1

meter above the ground surface. Operation in the horizontal mode gives about half the depth of penetration as vertical mode. The method of measuring the reproducibility of the electromagnetic instrument is specified in Section 4.3.1. The Geonics EM-31 instrument has an effective search radius of 7 to 10 feet for a buried metallic drum. Data will be electronically stored in a data logger from each station reading then downloaded daily to computer for storage on computer hard drive and disk. A hard copy of data will also be retained.

4.3 FIELD PROCEDURE

A trial survey traverse will be made across the OU5 area from north to south using the magnetometer and electromagnetic instruments. Following the traverses, the data will be reviewed to determine intensity and band of influence of the known features. The purpose will be to determine the response from these transected cultural features: railroad, chain-link fencing, natural gas pipeline, and 13.8 kilovolt electric utility line. If the station measurements adjacent to the controlled area fence reveal a prominently large anomaly, then only grid-traverse lines on the next 100-foot lines need to be measured. Other stations between this interval may be deleted.

The site selected for the fixed base station magnetometer will be pre-scanned over a 25-foot radius to clarify that no visible or buried ferromagnetic materials are present.

4.3.1 IHSS 115 Area

A baseline for the north coordinate boundary will be land surveyed approximately parallel to and along N747,700 feet. This line will be measured and marked by visible flagged stakes along its IHSS entirety each 25 feet. At these intervals, grid-traverse lines will be followed during the geophysical survey. Beginning at the north boundary line, southern traverses with the geophysical instruments will be made along each grid-traverse line bearing due south and controlled by compass. At each 10-foot division along the grid-traverse line, instrument readings

will be recorded for total magnetic field intensity, vertical magnetic gradient, horizontal electromagnetic component along with grid-traverse location coordinates. The OU5 Work Plan calls for a 25-foot grid spacing for the geophysical surveys. At IHSS 115, this grid spacing may not detect an individual drum. However, the cumulative anomaly generated by potentially more numerous but smaller conductive and ferromagnetic wastes should serve to meet the objective of defining the limits of the landfill at the 25-foot spacing.

To assure reproducibility of the geophysical survey data recorded by the designated electromagnetic and magnetic instruments, the following field procedure will be implemented:

1. Select a location in OU5 for the purpose of establishing a geophysical survey control station (GSCS) that is separated from visible interferences to the instruments.
2. Clear the GSCS with each instrument to assure that subsurface station conditions are constant with respect to total magnetic field and conductivity (in-phase and quadrature components).
3. Record the total magnetic field and conductivity values measured with the designated grid-roving instruments at the GSCS.
4. Note any site changes that could affect the values at the GSCS such as precipitation or snow cover.
5. Implement the check for instrument reproducibility at the GSCS during each day of the geophysical survey. Re-occupy the GSCS at these times: start of the survey, at mid-day, and at the close of the work day. Document the measured values obtained with the designated grid-roving instruments.

4.3.2 IHSS 133 Area

The northern side of the trapezoid described in Section 4.1.3 will be the beginning part of the geophysical traverses. It should be recognized that possible magnetic field interference to the field compass could arise near the railroad and steel fencing. Northern ends of grid-traverse lines

will be flagged after foresights are turned due north from the N747,600 baseline, measured on a 12 1/2-foot spacing, to avoid the magnetic interference of visible steel. Southerly traverses with the geophysical instruments will be made along each grid-traverse line bearing due south and controlled by compass. At each 10-foot division along the grid-traverse line, instrument readings will be recorded for total magnetic field intensity, magnetic gradient, electromagnetic components (horizontal and vertical modes), along with grid-traverse location coordinates.

Because definition of the boundaries of the IHSSs in the 133 group, especially the Ash Pits, will rely partly upon detecting suspected smaller ferromagnetic waste materials, the following preliminary field procedure will be implemented:

1. Perform preliminary grid-traverses over a designated line of stations at the Ash Pits.
2. Vary the height of the magnetometer sensor for each traverse repetition.
3. Record the total magnetic field strength measured with the designated field-roving magnetometer.
4. Interpret the data by comparing which of the preliminary grid-traverse sensor height positions resulted in the best definition of the geophysical anomalies.
5. Set the grid-roving magnetometer sensor similar to the height which resulted in the best anomaly resolution for surface geophysical surveying at the IHSS 133 area.

The procedure for measuring instrument reproducibility described in Section 4.3.1 will also be implemented in the IHSS 133 area during the surface geophysical survey.

4.4 DATA REDUCTION

The data will be managed using Geosoft computer software and then contoured in color to generate the following 11-by-17-inch maps:

1. Total magnetic field;
2. Vertical magnetic gradient;

3. EM-31 conductivity, for shallow subsurface conductivity; and
4. EM-31 in-phase, for shallow, subsurface metals.

Both geophysical survey methods would be expected to detect the buried natural gas pipelines in this area of OU5. The pipelines could create an interference anomaly band up to 25 feet in width contingent upon pipeline burial depth. When pipeline influences are determined and compensated for using the computer software program, other objects, such as waste materials, generating smaller proximity anomalous fields may be resolved.

4.5 INTERPRETATION OF TOTAL MAGNETIC FIELD, VERTICAL MAGNETIC GRADIENT, AND ELECTROMAGNETIC RESPONSE

Each geophysical map of the IHSS area will show the outline of anomalous areas and boundaries indicative of landfill limits based upon the compilation of magnetic and electromagnetic data evaluation. To the extent possible, each geophysical map in the IHSS 133 area will indicate the boundary of trenches associated with the Ash Pits or other suspected trenches. Because underground utility lines are expected, as indicated in Figure 1.4, these through-going pipelines shall be indicated and monumented on site by three visible flagged stakes at both end points and midline of the surveyed area. The locations of these buried utilities are required to be determined prior to initiating intrusive activities, such as borings at these IHSSs.

4.6 EXTENSION OF GEOPHYSICAL SURVEY

Should significant magnetic and/or electromagnetic anomalies be determined, the survey will be continued laterally or continued for an additional 50 feet along the line of traverse or parallel to the line of traverse. Those anomalies directly associated with pipelines and fences will not be extended.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

5.1 QUALITY ASSURANCE

Quality assurance for the surface geophysical surveys will be accomplished by six task-specific designs which include:

1. Final Phase I RFI/RI Work Plan for geophysical surveys on the IHSSs 115 and 133 groups.

2. This Technical Memorandum which generally describe:
   * geophysical survey locations and the mission to be accomplished;
   * geophysical instrumentation and ancillary equipment;
   * field methods; and
   * data interpretation.

3. Standard Operating Procedure GT.18 for electromagnetic surveys which include:
   * instruments and ancillary equipment to be used;
   * standard field procedures; and
   * standard procedures for processing and interpreting field data.

4. Document Change Notice 5-21000-OPS-GT.18 92.01 for magnetic surveys which include:
   * instruments and ancillary equipment to be used;
   * standard preliminary procedures pertaining to survey parameters, land survey, base station selection, operator apparel check, and RFP radiation survey;
   * designed field parameters for magnetometer grid locations and survey extension;
   * standard field procedures for conducting the survey; and
   * standard procedures for processing, interpreting and storing the data.

5. Task-specific surface geophysical work plans which include:
   * written field operation procedures for surface magnetic surveys;
   * written field operation procedures for surface electromagnetic surveys;
   * instrument calibration just prior to and immediately after the surveys; and
   * adequate documentation to provide traceability of field data.

6. Adherence of the geophysical task workers to the guidance and requirements of Radiation Safety, Standard Operating Procedure training, General Employee Training, and the approved Health and Safety Procedures.

5.2 QUALITY CONTROL

Quality control will be performed by verification of data and reports including:

1. Documentation and review by technically-qualified field geophysicists; and
2. Verification by the geophysical project manager for adherence to the project-specific work plan;
3. Document review and approval by both geophysical project manager and review principals for the surface geophysical reports.

The Draft, Revision 0, Technical Memorandum No. 2, July 31, 1992 was submitted for Agency Comment. Disposition in the form of written reply to the draft Comments is provided in Appendix 2. Those Comments have been incorporated or clarified within this Final, Revision 0, Technical Memorandum No. 2.

6.0 REFERENCES

DOE (Department of Energy), 1992a, Final Phase I RFI/RI Work Plan for Rocky Flats Woman Creek Priority Drainage (Operable Unit No. 5), Revision 1, February.

DOE 1992b, Historical Release Report for the Rocky Flats Plant, Environmental Restoration Program, June.

DOE 1992c, Technical Memorandum 1: Revised Network Design-Field Sampling Plan, OU5, In Preparation.

DOE 1992d, Technical Memorandum 3: Surface Soil Sampling - Original Landfill, In Preparation.

DOE 1992e, Technical Memorandum 4, Surface Soil Sampling, Ash Pits, In Preparation.

DOE 1992f, Technical Memorandum 5, Soil Gas Sampling, In Preparation.

DOE 1992g, Technical Memorandum 7, Soil Borings - Ash Pits, In Preparation.

DOE 1992h, Technical Memorandum 8, Monitor Well Installation - Original Landfill, In Preparation.

DOE 1992i, Technical Memorandum 9, Monitor Well Installation - Ash Pits, In Preparation.

EG&G 1992, EMD Operating Procedures Manual No. 5-21000 - OPS-GT. Volume III: Geotechnical.

EPA (Environmental Protection Agency), 1988. Aerial Photographic Analysis Comparison Report, U.S. D.O.E., Rocky Flats, Golden, Colorado, TS-PIC-99760, Appendix A, EPA Region 8, July.

IAG, 1991: Rocky Flats Interagency Agreement (Federal Facility Agreement and Consent Order), January 22, 1991.

Rockwell International, 1988. Draft Remedial Investigation and Feasibility Study Plans for Low Priority Sites. Rocky Flats Plant, Golden, Jefferson County, Colorado. Vol. 1. June 1988.

Van Blaircom, R., 1980. Practical Geophysics for the Exploration Geologist, Northwest Mining Association, Spokane, WA.

APPENDIX 1

DOCUMENT CHANGE NOTICE FOR MAGNETIC SURVEYS, WOMAN CREEK PRIORITY DRAINAGE AREA, OU5, RFP.

1.0 MAGNETICS

1.1 Introduction

Magnetic geophysical surveys provide a rapid, non-invasive means of measuring the earths' magnetic field. The magnetic field strength and gradient at any location is due primarily to the earths' magnetic core, local geologic materials, and the latitude and longitude of the site of interest. Due to the presence of the solar magnetic field surrounding the rotating earth, a diurnal fluctuation in the magnetic field also occurs. A secondary magnetic field may arise from anthropogenic sources including adjacent surface ferromagnetic objects such as steel fencing and vehicles. Additionally, subsurface objects such as utility lines or metal-containing drain pipes are also a factor. Overhead electric power lines also generate magnetic interference.

The method involves the measurement of magnetic intensity (total magnetic field) in gammas (γ), $1\ \gamma = 10^{-5}$ gauss at each ground survey station. Expected total magnetic field is approximately 50,000 γ. Magnetic anomalies may have an intensity of 50γ or more. Magnetic noise originates from subsurface geologic materials and may be approximately 5 to 10γ.

Anthropogenic components should be discerned prior to survey initiation. Data for total magnetic field is to be recorded using electronic data loggers. During field magnetic measurements, a fixed base station magnetometer will measure diurnal magnetic variation to provide compensation to the roving magnetometer data record. Field data will be downloaded to hard and floppy disks.

This DCN specifies procedures for surface magnetic surveys utilizing the EDA Omni magnetometer instrument or equivalent for both the tripod-mounted base station and the field-roving magnetometer.

1.2 Survey Design

1.2.1 List of Necessary Field Equipment

The following is a list of equipment that will necessary to complete a magnetic survey.

* Two EDA Omni magnetometers with integral data logger or equivalent;
* Tripod;
* Brunton compass or equivalent;
* Fiberglass tape, 300 feet;
* Field notebook;
* Black waterproof (permanent) pens;
* Flagging; and
* Wooden stakes.

1.2.2 Field Procedures

A standard field procedure is described below. Prior to magnetic data collection, five preliminary procedures must be conducted. These are:

* Design the appropriate field survey parameters given the purpose of coverage, contained areas of magnetic interference, grid-traverse spacing, direction of traverse, magnetometer reading interval.

* The surface geophysical survey grid-traverse lines will be controlled from the surveyed baseline provided by RFP plant personnel. The provided baseline will be staked each 25 feet. At these stakes grid-traverse line endpoints will be marked with flagged lath. The baseline and grid-traverse line stations of the magnetic survey will be transferred to the appropriate base map.

* The magnetic base station location will be selected, after consulting site utility maps, to assure minimal magnetic interference due to electric power lines, railroad, fencing, vehicular traffic, subsurface utilities, and air monitoring stations, or other metallic objects. The site should also be cleared with the portable magnetometer.

* The geophysical field instrument operator will check that personal clothing including watches, belt buckles and boots, do not contain interfering ferromagnetic materials.

* Initiate the magnetic survey only after an in situ gamma radiation survey has been completed by RFP plant personnel at each IHSS 115 and 133 groups.

Design of appropriate field parameters must consider the following:

* The roving magnetometer will be suspended on a staff 8 feet above ground surface at each station on the IHSS 115 survey area.

* The roving magnetometer will be suspended on a staff 4 feet above ground surface at each station on the IHSS 133 group survey area.

* Spacing between stations along each grid-traverse line stations will be 10 feet.

* Spacing between adjacent grid-traverse lines will be 25 feet at the IHSS 115 survey area.

* Spacing between adjacent grid-traverse lines will be 12 1/2 feet at the IHSS 133 group survey area.

* Grid-traverse line will be extended an additional 50 feet along significant anomaly indications. Where such anomalies are attributed directly to known pipeline, fences, or other visible and mapped anthropogenic ferromagnetic structures, the survey need not be extended.

* Definition of a magnetic anomaly requires three or more anomalous readings.

* Suspected anthropogenic interferences to the ambient magnetic field will be evaluated as to their mapped location and trend. Where utility line maps indicate pipelines and electric lines are present, the grid-traverse line will be oriented orthogonally where possible.

A standard field procedure for conducting a magnetic survey is indicated below.

* Perform a visual survey along the grid-traverse lines. The visual survey will include a review of: site utility plans, overhead electric lines, manhole collars, buried gas lines and their monuments. Plant personnel will confirm the presence of possible utility features. Note the location of any of these features in the field notebook and transfer their location to the appropriate map.

* Note in the field notebook ferromagnetic objects observed at the ground surface.

* Note in the field notebook large variations in topography or the proximity to buildings.

* Check the magnetometers and data loggers for sufficient battery charge and test the instruments using the manufacturers procedures.

* Setup and initiate the measurement of diurnal magnetic field variation using the tripod mounted base station magnetometer and data logger.

* Initiate a site survey along the grid-traverse line with the roving magnetometer. Magnetometer operation must follow manufacturer's operating procedure for total magnetic field and vertical magnetic gradient measurement.

* Check to determine if each magnetometer's measurements are being properly received and electronically stored in the data logger. Correlate the station number to the total magnetic and vertical magnetic gradient data entry with the grid location in the field notebook.

* In the field note book indicate the date and time of the start and end of each traverse made with the roving magnetometer.

* Continue the above procedure for each station along all grid-traverse lines.

* Label and/or number all notations on the field map corresponding to notes made in the field notebook.

* Download electronic data from the roving field magnetometer to a computer on a daily basis to hard drive and disk for further analysis.

* Download electronic data from the base station magnetometer to a computer on a daily basis to hard drive and disk.

1.2.3 Data Processing and Interpretation

A standard procedure for processing and interpreting the magnetometer data is described below.

* Collected data is downloaded from the base station and roving magnetometers to the computer. Compensation of measurements of total magnetic field collected by the roving magnetometer are made using the record of diurnal variation measured by the base station magnetometer. The total magnetic field and vertical magnetic gradient data is then processed. Data is then plotted and contoured at the appropriate scale for the base map selected.

* Process total magnetic field and vertical magnetic data for each IHSS area using computer software with hardware capable of generating contoured, colored maps on 11- by 17-inch paper.

* Generate an archival-quality computer disk DXF file capable for CADD color plotting, gridding, and contouring of the total magnetic field and vertical magnetic data at a selectable map scale.

* Compare the results of the total magnetic field and the vertical magnetic gradient to determine if subsurface anomalies are present.

APPENDIX 2

REPLY AND DISPOSITION OF AGENCY COMMENTS TO DRAFT TECHNICAL MEMORANDUM No. 2 (July 31, 1992)

1. U.S. Environmental Protection Agency, Region VIII

2. Colorado Department of Health

3. U.S. Department of Energy, Headquarters

4. U.S. Department of Energy, Rocky Flats Organization

REVIEW AND COMMENT RECORD **1. Page:** 1 of 3

2. Date: October 2, 1992

3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical Surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992

Reviewer's Name: Martin Hestmark **Agency:** U.S. EPA Region VIII **Date:** September 28, 1992

Item	Comment(s)	Disposition
General	Several of the tasks described have already been performed by EG&G. These include air photo analysis, ground truthing of the analysis, and staking of the inferred trench locations. The original purpose of the request for geophysical surveys was to confirm the locations of the trenches. Previous site visits by EPA have indicated that the locations of the trenches cannot be confirmed visually from the ground. Therefore, further extensive air photo and ground truthing activities should not be required before the geophysical survey is conducted. This will prevent extreme redundancy of tasks and may eliminate costs and delays associated with the investigation.	Part of the original aerial photograph analysis was correct because the disturbed areas were large and distinct, or consisted of large concrete dump areas (ie. Incinerator site [IHSS 133.5] and the Concrete Wash Pad [IHSS 133.6]) which were clearly visible on the vertical aerial photographs. The trenches comprising IHSS's 133.2, 133.3 and 133.4, however, are well documented on oblique photographs taken in 1969 and a good correlation was found to exist between the oblique photographs and the corresponding vertical photographs. This resulted in a more accurate location of these IHSS's and a modification of the locations previously delineated by the original review. Use of the oblique photographs also proved essential during the field survey because the IHSS's could be located by using the power line poles or other landmarks as reference points. The field investigation further determined that the trenches could be located within reasonable limits because they were generally delineated by mounds or depressions, and in most instances were partially defined by a difference in vegetation types and growth. IHSS 133.1 was found to be a concrete dump area that may or may not overly an ash pit. Based of the flat topography of the area and the conformity of the dump to the terrain, it appears doubtful that a pit does exist.

REVIEW AND COMMENT RECORD **1. Page:** 2 of 3

2. Date: October 2, 1992

3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical Surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992

Reviewer's Name: Martin Hestmark **Agency:** U.S. EPA Region VIII **Date:** September 28, 1992

Item	Comment(s)	Disposition
Section 1.2. Page 4 and 5.	The first paragraph states the use of the geophysical techniques will be considered for contingent implementation at IHSSs 133.1 through 133.6, based on the results of aerial photography review and the *in-situ* high purity germanium (HPGe) gamma survey. As stated in numerous scoping meetings, the geophysical survey should be conducted regardless of the results from these other tasks. Redundant air photo review has not confirmed the trench locations with known accuracy, and further review will not be likely to enhance this accuracy. Additionally, the gamma survey is unlikely to detect radionuclides if a significant thickness of clean soils overlies the trenches. A clean soil cover of 1 foot, if damp, would likely shield any underlying radionuclides in the trenches. As previously explained to EG&G on October 29, 1990, regarding the gamma survey at IHSS 115 (Old Landfill), the depth of detection for americium would likely be less than 3.5 centimeters. Therefore, the gamma survey could easily miss radionuclides in a trench if clean soils were used as cover. Because of these facts, the geophysical survey of the ash pit area should be conducted regardless of the results of these other surveys. It may be the only investigative procedure that can successfully locate these pits.	The statement that the geophysical surveys in the IHSS 133 area are contingent upon the results of the aerial photograph review and the HPGe *in-situ* gamma survey, are specified on page 7-16 of the OU5 Phase I Work Plan, Revision 1, dated February, 1992. We do concur that the EM and magnetometer surveys are justified even though the aerial photograph review has resulted in a better delineation of the IHSS's in the 133 group (see reply to comment for no. 1), and the HPGe survey should further define the lateral extent of the pits in the 133 area. Because of the limitations of not being able to detect buried radionuclides with the HPGe instrument, a boring program will be essential to determine the contents of the pits. The geophysical surveys are required to determine if metallic waste has been buried with the ash so that specified boring or sample sites may be selected. The benefits of the HPGe survey are two-fold. First, it can detect radioactive sources that are exposed at the surface, and second, Ron Reiman of EG&G/RFP has pointed out that disturbed ground (trench cover material) will generally contain lower levels of cesium^{137} than undisturbed ground. A review of the results of the IHSS 115 *in-situ* gamma radiation survey has confirmed his statement with cesium^{137} concentrations averaging 0.5 pCi/g in undisturbed sediments, and from .2 to .1 pCi/g in disturbed sediments (landfill cover).

REVIEW AND COMMENT RECORD

1. Page: 3 of 3

2. Date: October 2, 1992

3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical Surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992

Reviewer's Name: Martin Hestmark **Agency:** U.S. EPA Region VIII **Date:** September 28, 1992

Item	Comment(s)	Disposition
Section 2.1.1, Page 7, Second Paragraph.	Because the area of the landfill was not geologically mapped before dumping began, and has not been drilled through, any cross sections are speculative. Therefore, the presence of permeable alluvium or colluvium, or the lithology of the Arapahoe formation underlying the landfill is currently speculative also. Analysis of the dip angle and trends of the Arapahoe number 3, 4, and 5 sandstones indicate the possibility that one or more of these relatively permeable lithologies subcrop (underlie) the landfill. If this is the case, leachate flow could take a different direction than stated. This section should recognize this possibility.	Bore hole 426-92 was drilled north and adjacent to the Original Landfill in 1992. It was drilled to a depth of 158 feet, and is added to cross section A-A' in TM2. This hole confirms the lithology and stratigraphy originally shown on the cross section, and confirms that the landfill is underlain by claystones of the Arapahoe Formation. Because of lost core intervals, it could not be fully determined from the lithologic logs if some Arapahoe Sandstone intervals could exist in the bore hole. Annetta Primerose of EG&G/RFP confirmed (October 1, 1992) that the electric logs of hole 426-92 indicated that the entire interval below the unconformity/bedrock contact consists entirely of claystone. The information provided in the cross sections is valid.

REVIEW AND COMMENT RECORD	1. Page 1 of 3 2. Date: October 2, 1992
3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical Surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992	
Reviewer's Name: Gary W. Baughman **Agency:** Facilities Section Hazardous Control Program Colorado Department of Health 320-8333	**Date:** August 31, 1992

Item	Comment(s)	Disposition
TM2 Maps	The OU boundary shown on several figures within the document does not accurately portray the "Woman Creek Priority Drainage" as envisioned by the IAG and should be removed.	The OU5 boundary will be deleted from the TM 2 maps. Text citation of the **Operable Unit** will be changed to "Woman Creek Priority Drainage".

REVIEW AND COMMENT RECORD

1. Page 2 of 3

2. Date: October 2, 1992

3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical Surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992

Reviewer's Name: Gary W. Baughman **Agency:** Facilities Section Hazardous Control Program
Colorado Department of Health
320-8333

Date: August 31, 1992

Item	Comment(s)	Disposition
Figure 1.4	The trapezoidal geophysical survey area for the ash pits shown on Figure 1.4 does not include several of the anomalies indicated on Figure 2.8. In addition, it differs from the survey area presented in the Final OU 5 RFI/RI Work Plan. We recommend expanding the survey area westward approximately 200' to pick up the disturbed ground area west of the access road and expanding it as far northward as possible to pick up the new possible ash pits. Also, to be consistent with the text of TM 2 and the Work Plan for OU 5, the area shown on Figure 1.4 should be expanded southward to Woman Creek.	Figure 1.4 of TM2 shows the original IHSS locations as delineated in the OU5 Phase I RFI/RI Work Plan, while Figure 2.8 shows the revised locations of the IHSS's and other features as identified during the initial review of the vertical aerial photographs. After the TM was submitted for review a set of oblique aerial photographs became available that made it possible to more accurately relocate the IHSS's in the 133 area and to further define other possible suspect features. The oblique photographs were subsequently used to confirm these features on the ground. As a result Figure 2.8 is updated with respect to the IHSS and suspect area locations. The areas of disturbed ground shown on the west side of the area were determined to be associated with road construction. These were discussed on pages 9 and 10 of TM2, and do not warrant further investigation. The north boundary of the survey area is adequately located to included all suspect areas that warrant further investigation. A ground survey of the area determined that some of the suspect areas are predominately dumped concrete with no indications of buried pits. The southern boundary of the geophysical surveys will be extended to conform to the boundaries of the radiation survey.

REVIEW AND COMMENT RECORD

1. Page 3 of 3

2. Date: October 2, 1992

3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical Surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992

Reviewer's Name: Gary W. Baughman **Agency:** Facilities Section Hazardous Control Program
Colorado Department of Health
320-8333

Date: August 31, 1992

Item	Comment(s)	Disposition
Figure 2.7	The oblique aerial photo included as Figure 2.7 should have a date indicated on the photo label.	The photograph used in Figure 2.7 is provided with the date of June 6.
General	An HPGe radiation survey is planned for the ash pits area covering the same area that will be geophysically surveyed. We recommend that the HPGe survey precede the geophysical surveys.	This general comment restates the task work prioritization for Stage 2 screening specified in the OU5 RFI/RI Work Plan, Phase I Field Sampling Plan, dated February 1992. A statement so indicating this directive for the Ash Pits has been added to Section 2.1.3 indicating this part of the site assessment task sequence.

REVIEW AND COMMENT RECORD

1. Page 1 of 5

2. Date: October 2, 1992

3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992

Reviewer's Name: U.S. Department of Energy Headquarters

Agency: U.S. Department of Energy, Headquarters 966-2184

Date: September 30, 1992

Item	Comment(s)	Disposition
Section 1.2, Page 4, Last sentence	It is noted that "the second implementation will be initiated based upon the results of the aerial photography review..." Please define the phrase "second implementation". If this is the geophysical survey, then please state this fact.	Text is revised to read: "The contingent implementation of surface geophysical surveys will be initiated based upon the results of the aerial photography review and *in-situ* HPGe gamma radiation survey".
Section 1.2, Page 5, Second Paragraph	The second purpose of the aerial photographic review is to "identify other prominent features". Please be more specific. State exactly what was looked for in the review.	Text is modified to read: "identify other prominent features, including disturbed ground, mounds, trenches or depressions that were not identified in the Phase I RFI/RI Work Plan".
Section 1.2, Page 6, First Paragraph	Please define the phrase "aerial photographic anomalies".	The term **aerial photographic anomalies** is omitted and substituted with: "indicated disturbed sites identified on the aerial photographs---".
Section 1.2, Page 6, Second Paragraph	Please explain in greater detail how the results of this study will effect the design of sampling plans (to be) presented in the Technical Memorandums 3, 4, 5, 7, 8, and 9.	Technical Memorandum No. 1 is added to the list. Technical Memorandum No.2 is revised to include a discussion on how the detection of metallic debris, including possible buried drums, will help determine the locations of soil sample sites, soil gas sites, soil borings, bore holes and monitor wells.
Section 2.1.1, Page 7	This section should discuss the geophysical "foot-print" of the Rocky Flats Plant, especially in regards to how this will effect conducting the electromagnetic surveys.	Section 2.2.1 covers geology only; any discussion relating to the geophysical "footprint" of the RFP should probably be included in sections 3.0 through 3.2. We interpret the term "footprint" to mean the geophysical response that can be expected over an undisturbed area. We do not have access to this data at this time.

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3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992		
Reviewer's Name: U.S. Department of Energy Headquarters	Agency: U.S. Department of Energy, Headquarters 966-2184	Date: September 30, 1992

Item	Comment(s)	Disposition
Section 2.1.1, Page 7, Second Paragraph, Fourth Sentence	Please delete this sentence about the direction that landfill leachate would tend to migrate. The sentence is out of place (i.e., this is a simple description of the geology), serves no apparent purpose, and is conjectural (i.e., belongs in a section on the site conceptual model).	The wording on landfill leachate is deleted from the text.
Section 2.1.3, Page 8	Please clarify how the gamma radiation survey results control the geophysical surveys. There does not appear to be any relationship shown between this survey and the geophysical surveys proposed in this document.	The Final Phase I RFI/RI Work Plan states that the HPGe surveys will precede the geophysical surveys. Technically, neither survey results "controls" the other. Either could be performed prior to the other. However, from a health standpoint, radiation screening, in areas reported to contain radionuclide wastes, is prudent. This would protect succeeding task workers from potential contact with surficial, excessively radioactive metals. Hence, the task sequencing given in the Final Phase I RFI/RI OU5 Work Plan is for radiation surveys to precede all other task work.
Section 3.2, Page 12, First Paragraph	The document should clarify what constitutes "discernable burial depths" and the relationship between this depth and the target depths for these sites.	The text in Section 3.2 has been supplemented with reported depths of waste burial and the capability of their detection using the recommended surface geophysical methods. The phrase "discernible burial depth" was used to indicate that a given object, detectable with a suitable instrument, could be rendered undetectable if the object was located at a depth beyond the capability range of the instrument. It is not the intent of that section to describe the capabilities of the instrumentation; these are left for a following section. This section is intended to summarize the characteristics of the geophysical targets at these IHSS groups.

REVIEW AND COMMENT RECORD		1. Page 3 of 5 2. Date: October 2, 1992
3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992		
Reviewer's Name: U.S. Department of Energy Headquarters	**Agency:** U.S. Department of Energy, Headquarters 966-2184	**Date:** September 30, 1992

Item	Comment(s)	Disposition
Section 3.2, Page 12	This section should be deleted. A discussion of a landfill site in Florida does not add to the creditability of conducting these surveys at Rocky Flats where the geological conditions are different.	The case history example is deleted from Section 3.3.
Section 4.0, Page 14, First Paragraph	The use of the term "environmental evaluation" in this context is incorrect. In the Rocky Flats Environmental Restoration program, environmental evaluation refers to the data collection activities associated with ecological risk assessment. It appears that site characterization is what is meant.	The phrase **environmental evaluation** has been reworded to read "site assessment".

REVIEW AND COMMENT RECORD **1. Page** 4 of 5

2. Date: October 2, 1992

3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992

Reviewer's Name: U.S. Department of Energy Headquarters **Agency:** U.S. Department of Energy, Headquarters 966-2184 **Date:** September 30, 1992

Item	Comment(s)	Disposition
Section 4.0, Page 14, Second Paragraph	The original Work Plan for Operable Unit 5 did not contain plans for a geophysical survey. Please describe the new finding or insights that lead to the decision to implement the geophysical surveys.	The procedures provided in the Final OU5 Phase I RFI/RI Work Plan, Revision 1, dated February 1992 on pages 7-9 and 7-16 apply to IHSS 115 and 133 areas respectively. At IHSS 115, magnetic and electromagnetic geophysical surveys are specified with details of implementation to be described in an Agency-reviewed Technical Memorandum. At the IHSS 133 area these same geophysical procedures are provided in contingency for parts of the Observational Approach for covered waste delineation. The surveys were to be performed **if** the results of previous activities failed to adequately outline locations, or new findings from data review indicate new significant, and appropriate suspect surface disturbances in the IHSS 133 area. Based upon Stage 1 (review of aerial photographs) directed activities, the following conclusions and new findings were made: 1) previously unidentified significant surface disturbances were located on historical photographs; and 2) significant error and oversight of the IAG mapped location of several of the 133 IHSSs were found. In addition soil cover over possible radioactive waste sites such Ash Pit trenches, will limit detection by the prior *in-situ* gamma radiation survey. For these three reasons the geophysical surveys were deemed justified at the IHSS 133 area. A statement of these findings were given in the last paragraph of the commented page.

REVIEW AND COMMENT RECORD		1. Page 5 of 5 2. Date: October 2, 1992
3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992		
Reviewer's Name: U.S. Department of Energy Headquarters	**Agency:** U.S. Department of Energy, Headquarters 966-2184	**Date:** September 30, 1992

Item	Comment(s)	Disposition
Section 4.1.1, Page 15, First Paragraph	The discussion relates applying the standard operation procedure (SOP) for conducting electromagnetic surveys to the magnetic surveys is justifiable. The recommended approach would be to identify this section as an addendum to SOP GT.18 and not place this discussion in the body of the memorandum.	The discussion on procedural SOP transferability for magnetic surveys has been deleted. A Document Change Notice, instead of an addendum to SOP GT.18, specifically addressing equipment, field procedures, data processing, and interpretation of the magnetic survey has been submitted to EG&G. The DCN will provide guidance in the performance of task procedures.

REVIEW AND COMMENT RECORD

1. Page 1 of 2

2. Date: October 2, 1992

3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical Surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992

Reviewer's Name: Bruce Thatcher **Agency:** U.S. Department of Energy, RFO Bldg. 116, 966-2184 **Date:** September 8, 1992

Item	Comment(s)	Disposition
Page 1	This TM lacks sufficient QA/QC protocol.	A section on quality assurance has been added for the geophysical surveys.
Page iii	Delete word **Total** after Figure 2.8.	The word is deleted.
Page 14, Second Sentence	**Environmental evaluation** wording is questioned.	Text has been changed to "site characterization".
Page 15	Justification for the magnetic survey to follow the procedures of SOP GT.18 is questioned.	Text has been revised. A Document Change Notice has been prepared specifying procedures for the magnetic surveys.
Section 4.1.3, Page 16	The wording **anticipated geophysical interference** is questioned.	The field geophysical surveys will begin with a preliminary grid-traverse over known surface and underground utility lines and surface steel such as chain link fencing. This will provide advance knowledge of these anticipated geophysical interferences.
Page 17	In the second sentence, **12 1/2** foot grid-traverse spacing is questioned.	The nature of the magnitude of the geophysical target metallic materials are believed more difficult to determine on the specified 25-foot grid spacing. Because the baseline land survey spacing control was originally 25 feet, doubling of the grid-traverse lines was deemed prudent to improve anomaly detection. A convenient spacing based on the land survey is 12 1/2 feet to provide greater resolution. Hence this new spacing is 12 1/2 feet.

REVIEW AND COMMENT RECORD

1. Page 1 of 2

2. Date: October 2, 1992

3. Document No./Title: Draft Technical Memorandum No. 2, Addendum to Final Phase I RFI/RI Work Plan Surface Geophysical Surveys, Rocky Flats Plant, Woman Creek Priority Drainage Revision 0, July 31, 1992

Reviewer's Name: Bruce Thatcher **Agency:** U.S. Department of Energy, RFO Bldg. 116, 966-2184 **Date:** September 8, 1992

Item	Comment(s)	Disposition
Section 4.2.1, Page 17	The height of magnetic field sensors above the ground surface is requested.	The height of the magnetic sensors are stated in the revised text. Because the targets are potentially more difficult to detect in the IHSS 133 area, the sensors will likely be nearer to ground surface than for the IHSS 115 area as explained in the text. Optimized sensor positioning is given.
Section 4.2.2, Page 18	Vertical magnetic gradient should be inserted following total magnetic field intensity here and in succeeding sections.	The insertion requested is added.
Page 19	Because of the pipelines it is better to heir geophysical effect where they are known to be present in the subsurface and map it out in the survey areas.	This will be performed in the field during the preliminary grid-traverses to give background response of anthropogenic materials and to provide guidance for data resolution during the remaining part of the survey. This preliminary information can be useful for software manipulations of these determined anomalies in areas of discovered anomalies.

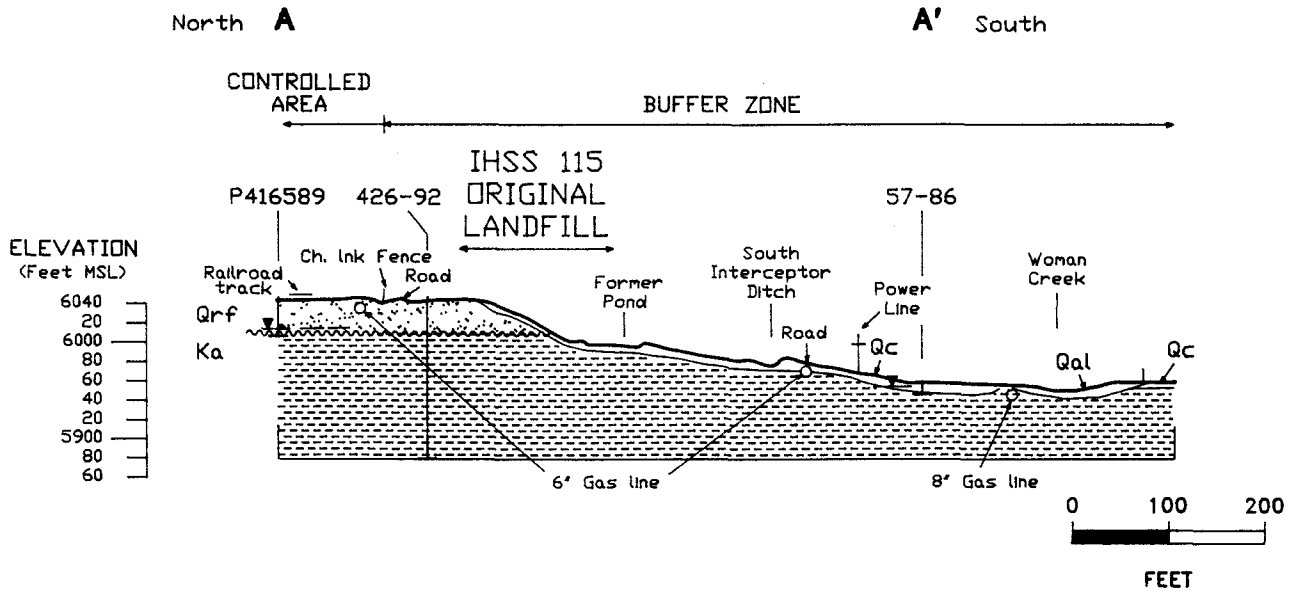
WOMAN CREEK PRIORITY
DRAINAGE AREA AT
ROCKY FLATS PLANT

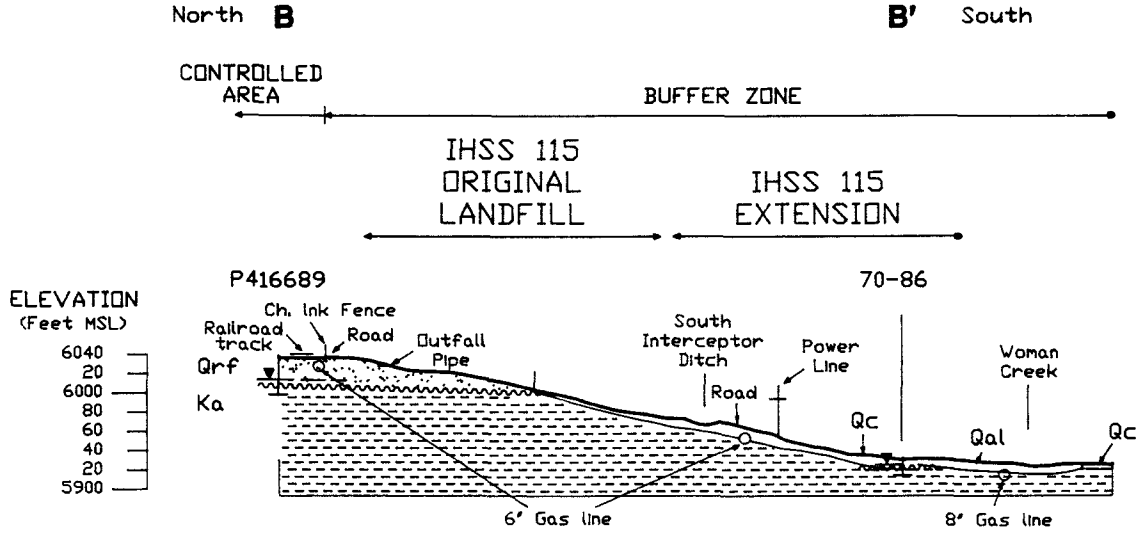
(OPERABLE UNIT 5)
TECHNICAL MEMORANDUM 2

EG&G FIGURE 1.1

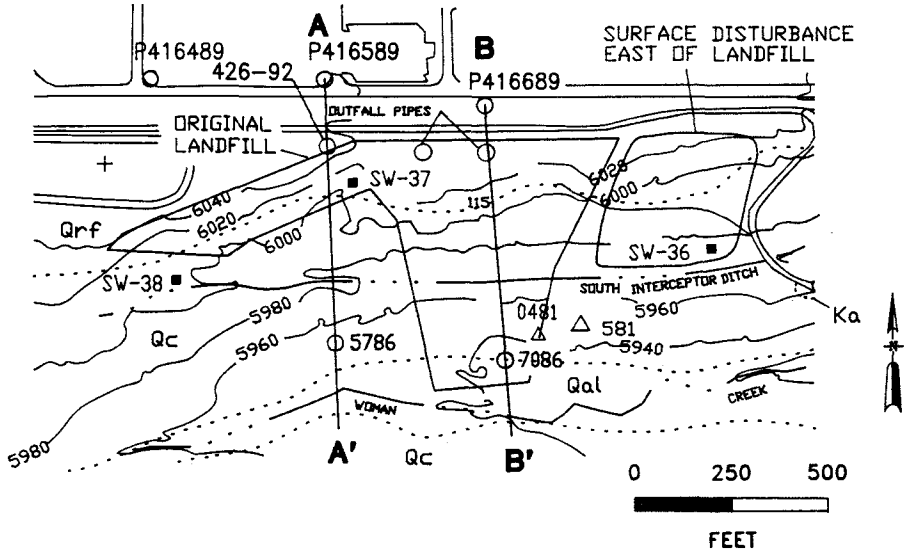
Rocky Flats Plant, Golden, Colorado

GEOLOGIC CROSS SECTIONS OU5





GEOLOGIC MAP



EXPLANATION

Quaternary

- Qal — Recent Valley Fill
- Qc — Colluvium
- Qrf — Rocky Flats Alluvium
- ~~~ — Unconformity

Cretaceous

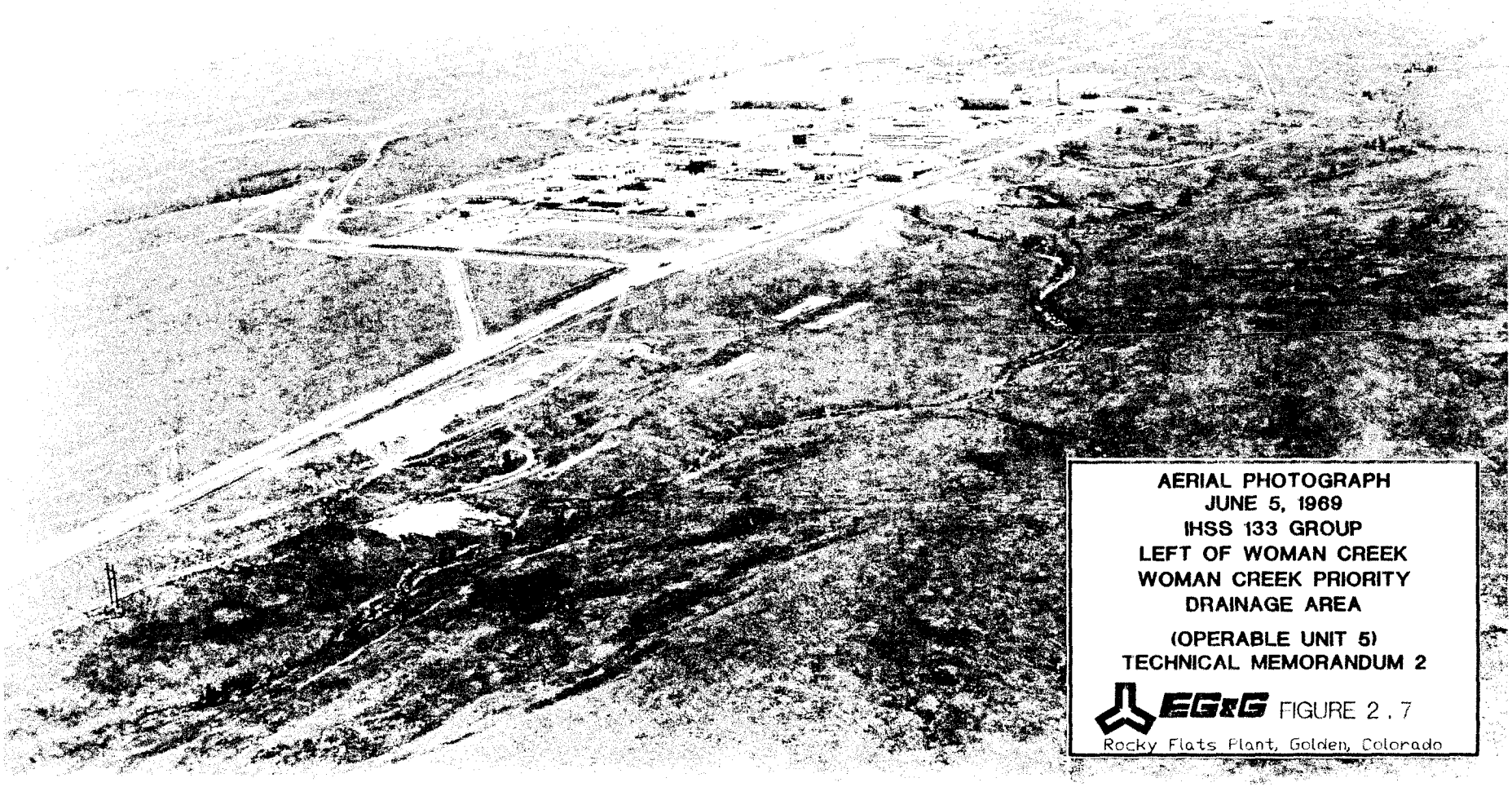
- Ka — Arapahoe Formation, Claystone
- Borehole
- Contact
- Water Depth

IHSS 115
GEOLOGIC CROSS SECTIONS A - A' AND B - B'
WOMAN CREEK PRIORITY DRAINAGE AREA
(OPERABLE UNIT 5)
TECHNICAL MEMORANDUM 2

EG&G FIGURE 2.2

Rocky Flats Plant, Golden, Colorado

05TM22-2.DWG

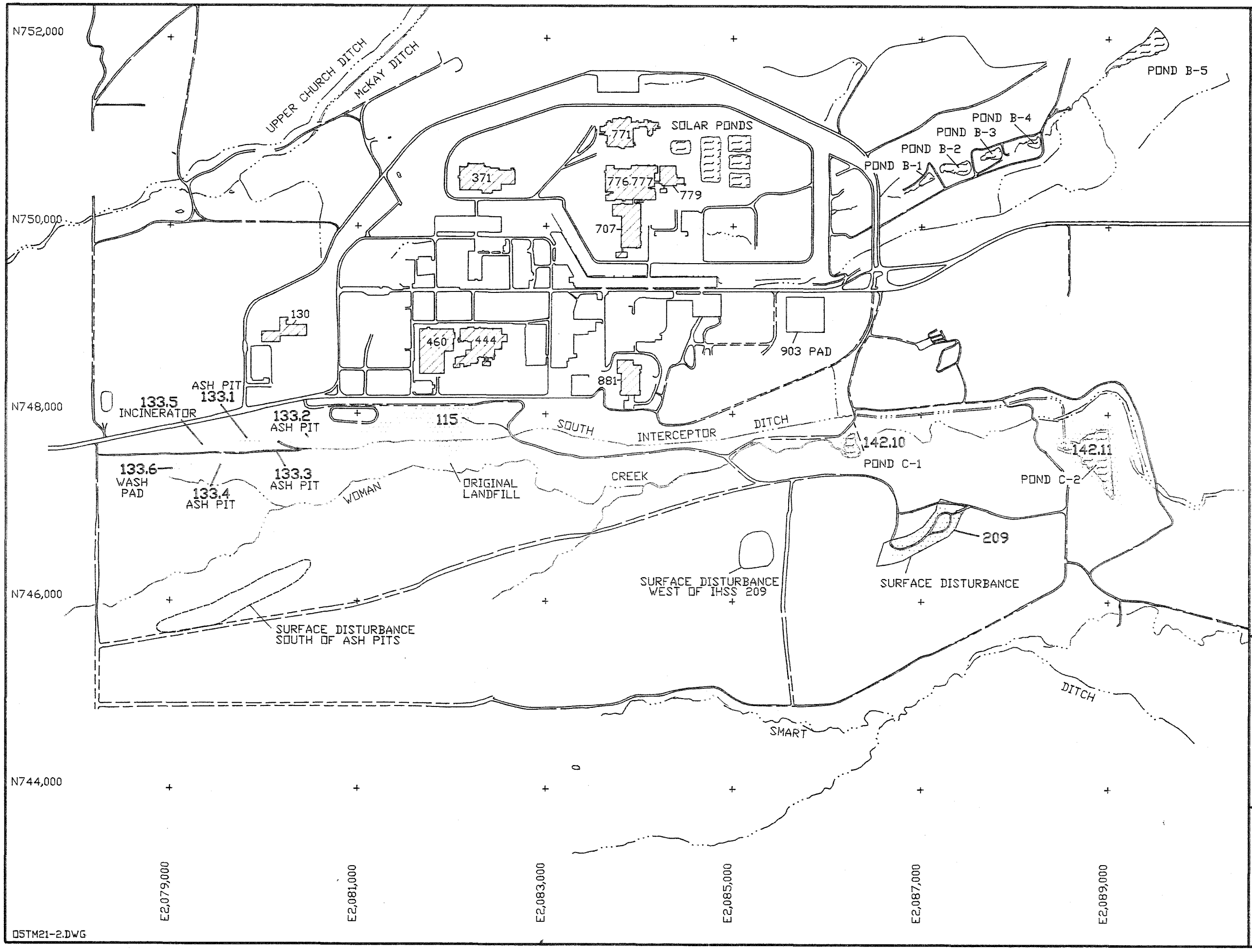


AERIAL PHOTOGRAPH
JUNE 5, 1969
IHSS 133 GROUP
LEFT OF WOMAN CREEK
WOMAN CREEK PRIORITY
DRAINAGE AREA

(OPERABLE UNIT 5)
TECHNICAL MEMORANDUM 2

EG&G FIGURE 2.7

Rocky Flats Plant, Golden, Colorado


N752,000
N750,000
N748,000
N746,000
N744,000
E2,079,000
E2,081,000
E2,083,000
E2,085,000
E2,087,000
E2,089,000
UPPER CHURCH DITCH
McKAY DITCH
SOLAR PONDS
771
371
776,777
779
707
POND B-5
POND B-4
POND B-3
POND B-2
POND B-1
130
460
444
881
903 PAD
ASH PIT
133.1
133.5
INCINERATOR
133.2
ASH PIT
115
SOUTH INTERCEPTOR DITCH
142.10
POND C-1
142.11
POND C-2
133.6
WASH PAD
133.4
ASH PIT
133.3
ASH PIT
WOMAN CREEK
ORIGINAL LANDFILL
209
SURFACE DISTURBANCE WEST OF IHSS 209
SURFACE DISTURBANCE
SURFACE DISTURBANCE SOUTH OF ASH PITS
SMART DITCH
MAP LEGEND
STREAMS DITCHES DRAINAGE FEATURES
PAVED ROADS
DIRT ROADS
SURFACE WATER IMPOUNDMENTS
BUILDINGS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES (APPROXIMATE LOCATION)
N
0 500 1000
FEET
BUFFER ZONE
CONTROLLED AREA
RFP BOUNDARY
WOMAN CREEK PRIORITY DRAINAGE AREA
(OPERABLE UNIT 5)
TECHNICAL MEMORANDUM 2
EG&G
FIGURE 1.2
Rocky Flats Plant, Golden, Colorado
05TM21-2.DWG

460

WATER TREATMENT PLANT

460

444

OUTFALL PIPES

115

N748,000

SURFACE DISTURBANCE EAST OF LANDFILL

DITCH

SOUTH INTERCEPTOR

WOMAN CREEK

E2,081,000

E2,083,000

5980

5960

5940

6000

6020

4 7 10 13

MAP LEGEND

- STREAMS DITCHES DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- SURFACE WATER IMPOUNDMENTS
- BUILDINGS
- 115 ORIGINAL LANDFILL
- U238 ISOCONCENTRATION CONTOURS (pCi/gm)

N

0 100 200

FEET

CONTROLLED AREA

RFP BOUNDARY

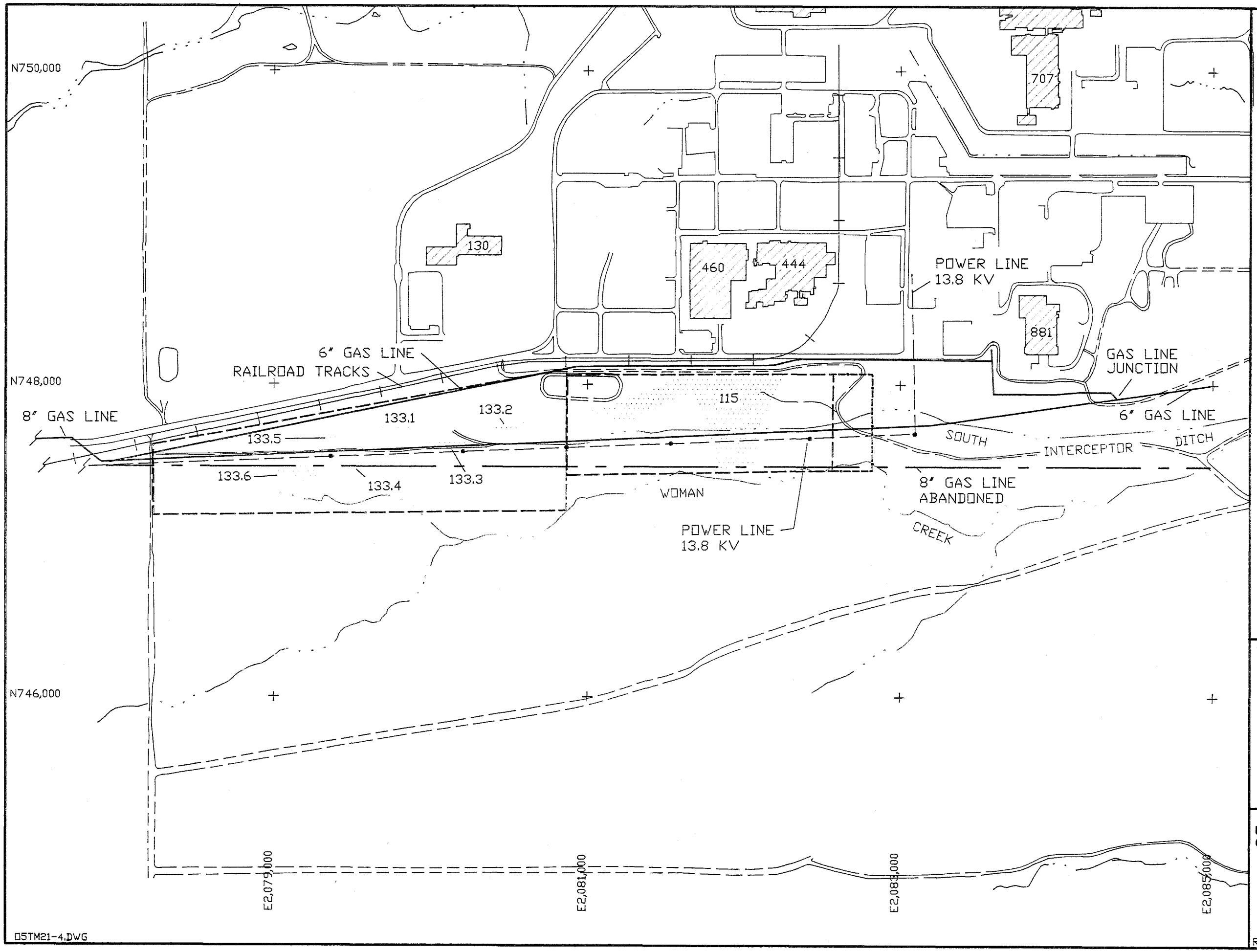
IHSS 115 ORIGINAL LANDFILL SITE LOCATION MAP WITH U238 ISOCONCENTRATION CONTOURS WOMAN CREEK PRIORITY DRAINAGE AREA

(OPERABLE UNIT 5) TECHNICAL MEMORANDUM 2

EG&G FIGURE 1.3

Rocky Flats Plant, Golden, Colorado

05TM21-3.DWG



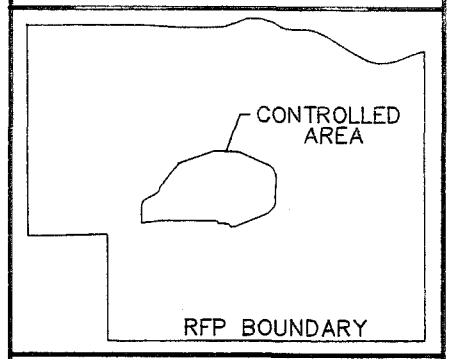
MAP LEGEND

- STREAMS DITCHES DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- BUILDINGS
- INDIVIDUAL HAZARDOUS SUBSTANCE SITES (APPROXIMATE LOCATION)
- GEOPHYSICAL SURVEY AREA
- EXTENDED SURVEY AREA

N

0 300 600

FEET



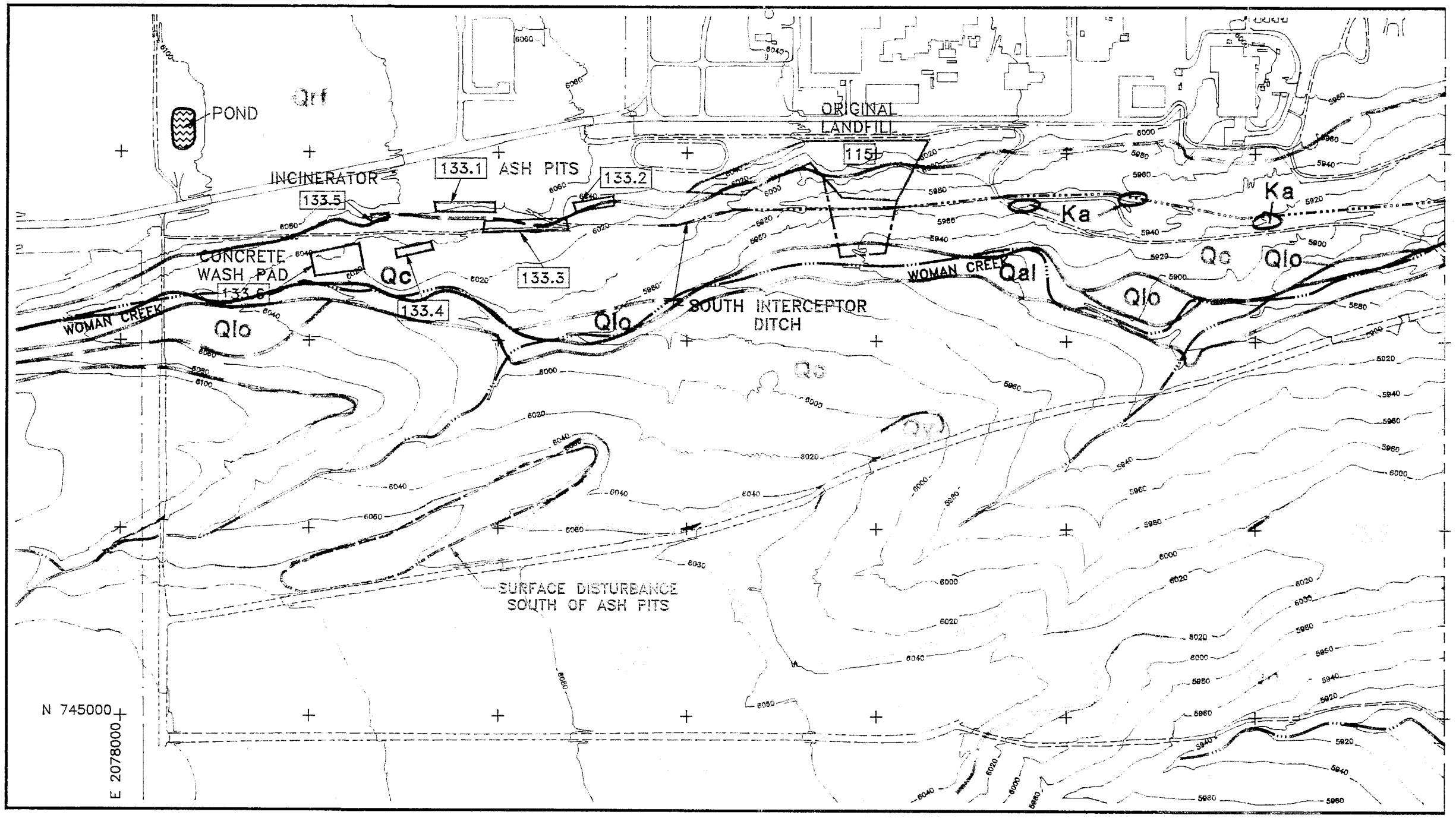
RAILROADS, UTILITY LINES, UNDERGROUND PIPELINES, AND GEOPHYSICAL SURVEY AREAS WOMAN CREEK PRIORITY DRAINAGE AREA

(OPERABLE UNIT 5) TECHNICAL MEMORANDUM 7

EG&G FIGURE 1.4

Rocky Flats Plant, Golden, Colorado

05TM21-4.DWG



EXPLANATION

- INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS) IN OPERABLE UNIT 5
- 115 — IHSS REFERENCE NUMBER
- INTERMITTENT STREAM
- DIRT ROAD
- PRELIMINARY EXTENSION OF THE SURFACE DISTURBANCE BASED ON A RECONNAISSANCE

CONTACT

- DASHED WHERE APPROXIMATELY LOCATED, QUERIED WHERE INFERRED.

QUATERNARY

Qal	RECENT VALLEY FILL
Ql	LANDSLIDE
Qc	COLLUVIUM
Qlo	LOUVIERS ALLUVIUM
Qs	SLOCUM ALLUVIUM
Qv	VERDOS ALLUVIUM
Qrf	ROCKY FLATS ALLUVIUM

CRETACEOUS

Kass	ARAPAHOE FORMATION, SANDSTONE
Ka	ARAPAHOE FORMATION, CLAYSTONE

SOURCE: DOE, 1992a

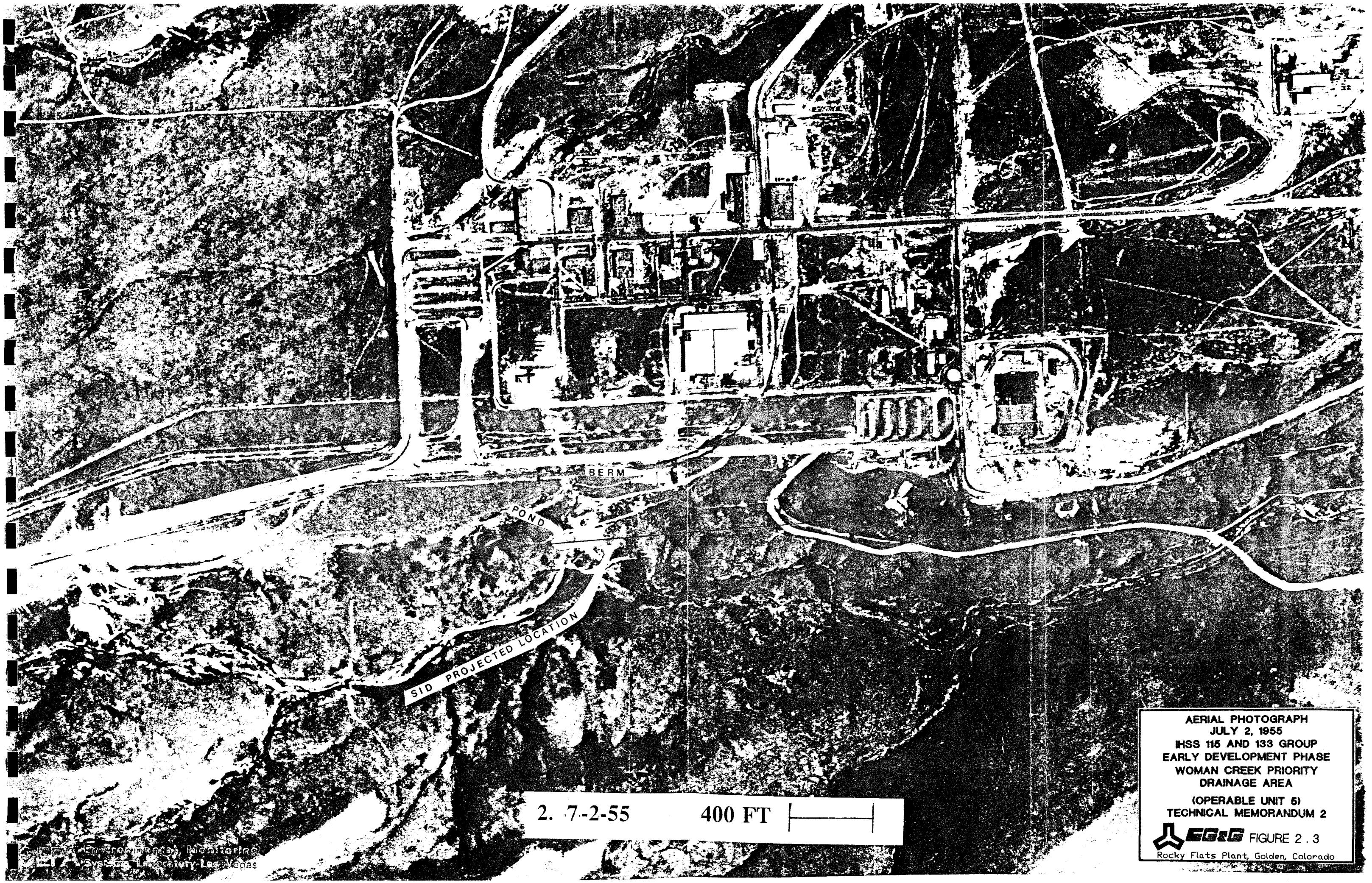
2506001A

SURFICIAL GEOLOGY WOMAN CREEK PRIORITY DRAINAGE AREA

(OPERABLE UNIT 5) TECHNICAL MEMORANDUM 2

EG&G FIGURE 2.1

Rocky Flats Plant, Golden, Colorado



AERIAL PHOTOGRAPH
JULY 2, 1955
IHSS 115 AND 133 GROUP
EARLY DEVELOPMENT PHASE
WOMAN CREEK PRIORITY
DRAINAGE AREA

(OPERABLE UNIT 5)
TECHNICAL MEMORANDUM 2

EG&G FIGURE 2.3
Rocky Flats Plant, Golden, Colorado

460

WATER TREATMENT PLANT

460

444

SURFACE DISTURBANCE EAST OF LANDFILL

OUTFALL PIPES

N748,000

115

5020

5000

5040

INDICATED CORRECTED LOCATION OF FORMER POND 7-2-55

INDICATED ADDITIONAL LANDFILL 6-7-88

POSSIBLE PIT 8-7-69

BERM 8-6-71

5000

5980

DITCH

SOUTH INTERCEPTOR

5960

5940

INDICATED DISTURBED GROUND OR LANDFILL PRIOR TO SID DEVELOPMENT

5000

5980

WOMAN CREEK

5940

5960

E2,081,000

E2,083,000

MAP LEGEND

STREAMS DITCHES DRAINAGE FEATURES

PAVED ROADS

DIRT ROADS

BUILDINGS

115 ORIGINAL LANDFILL

EXTENDED OR CORRECTED LOCATION FROM AERIAL PHOTOGRAPHS WITH PHOTOGRAPH DATE

N

0 100 200

FEET

CONTROLLED AREA

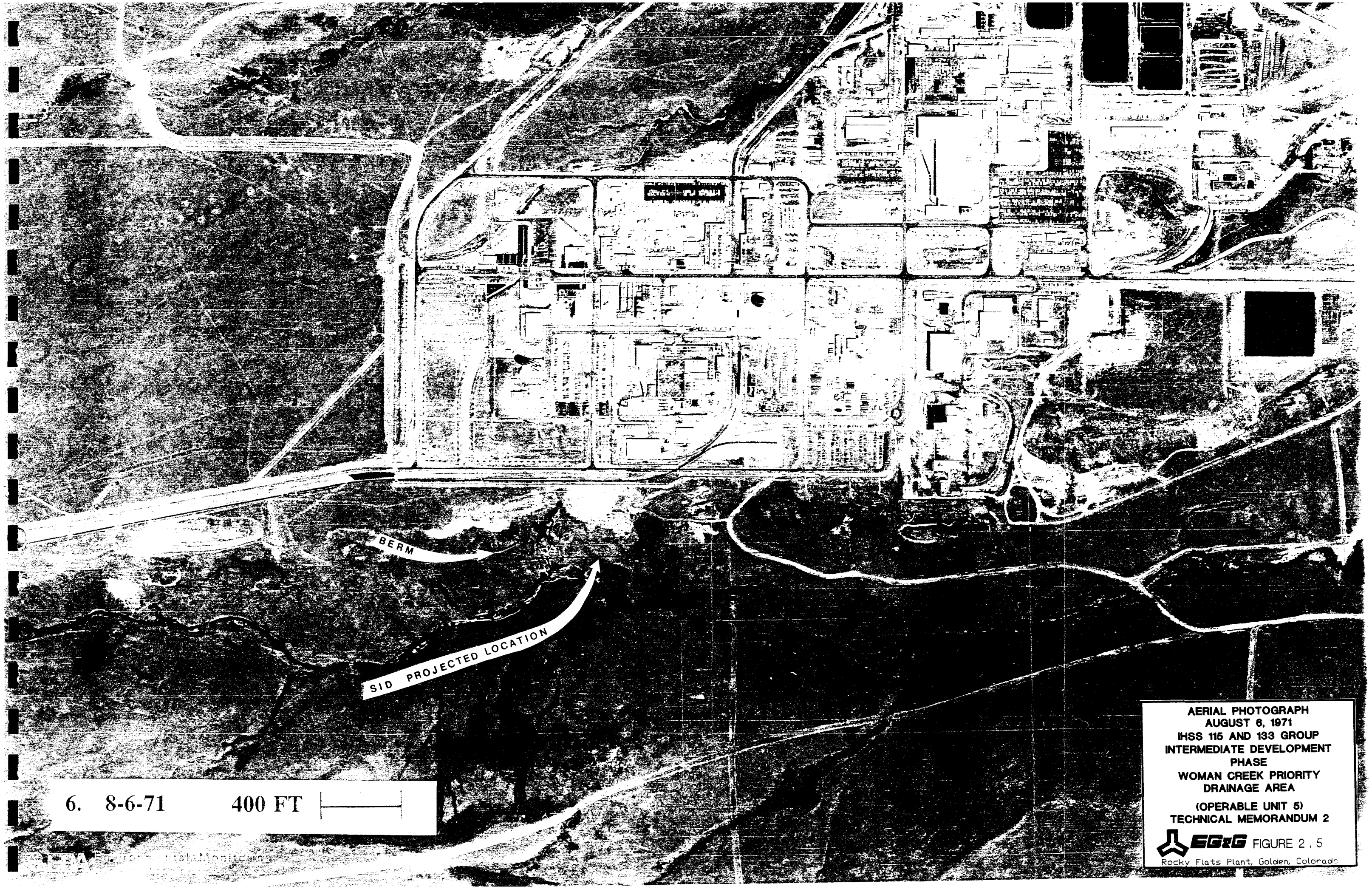
RFP BOUNDARY

IHSS 115 ORIGINAL LANDFILL AND EXTENDED AREAS WOMAN CREEK PRIORITY DRAINAGE AREA

(OPERABLE UNIT 5) TECHNICAL MEMORANDUM 2

EG&G FIGURE 2.4

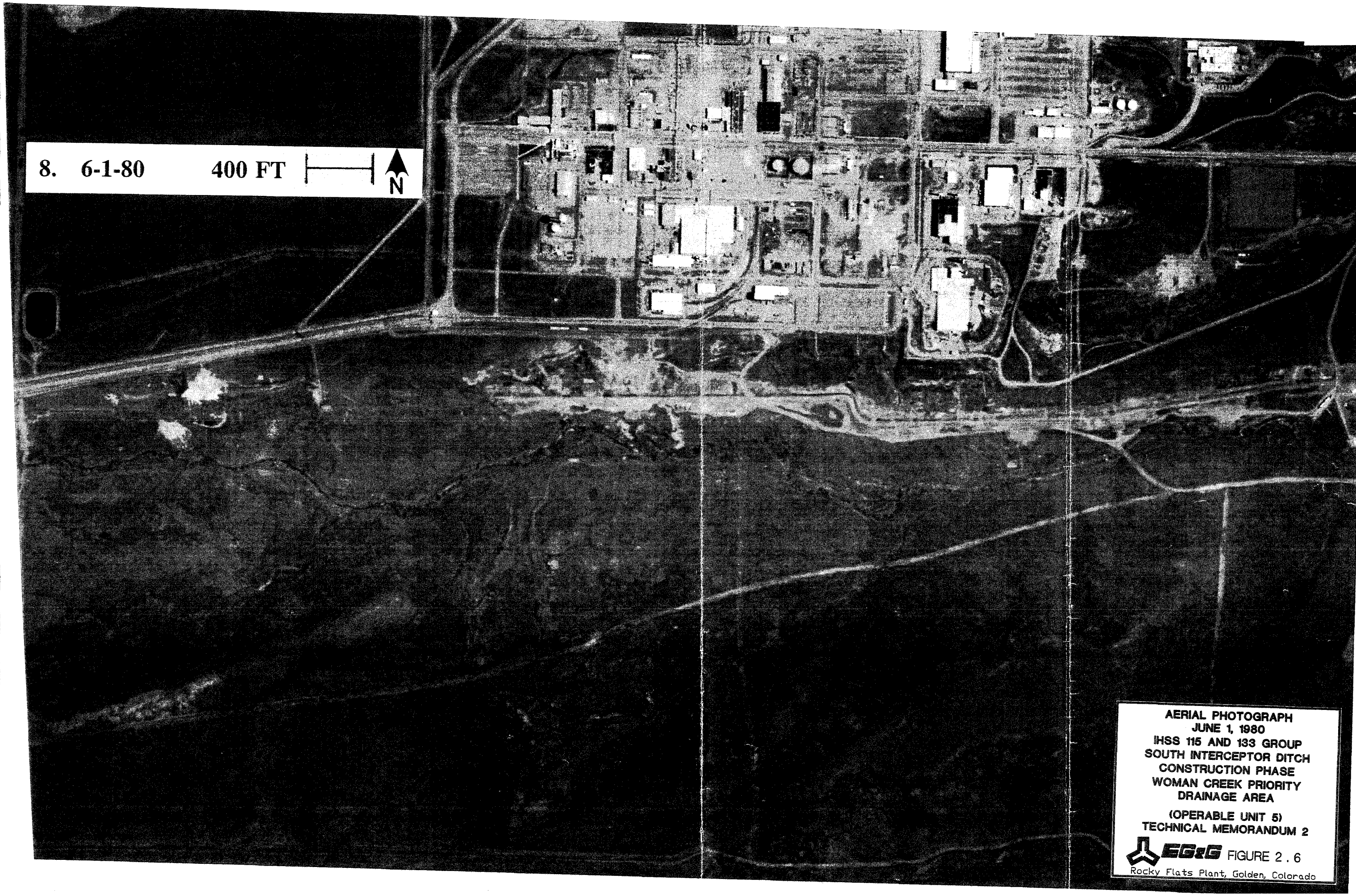
Rocky Flats Plant, Golden, Colorado



AERIAL PHOTOGRAPH
AUGUST 6, 1971
IHSS 115 AND 133 GROUP
INTERMEDIATE DEVELOPMENT
PHASE
WOMAN CREEK PRIORITY
DRAINAGE AREA

(OPERABLE UNIT 5)
TECHNICAL MEMORANDUM 2

EG&G FIGURE 2.5
Rocky Flats Plant, Golden, Colorado



AERIAL PHOTOGRAPH
JUNE 1, 1980
IHSS 115 AND 133 GROUP
SOUTH INTERCEPTOR DITCH
CONSTRUCTION PHASE
WOMAN CREEK PRIORITY
DRAINAGE AREA

(OPERABLE UNIT 5)
TECHNICAL MEMORANDUM 2

EG&G FIGURE 2.6
Rocky Flats Plant, Golden, Colorado

N749,000

N748,000

N747,000

6080

6100

6060

6050

6040

6020

6000

5980

5960

NORTHWEST ACCESS RD.

FIRST ST.

SECOND ST.

WEST ROAD

CACTUS AVE.

DISTURBED GROUND
7-2-55

DISTURBED GROUND WITH
CONCRETE DUMPS AND
ASPHALT SLABS
1953-1988

DUMPED CONCRETE
10-15-64

DRAINAGE
DITCH
1964

MOUND
8-7-69

133.1 (?)
ASH PITS

CONCRETE
PAD

133.5
INCINERATOR

CONCRETE
SLAB

DISTURBED GROUND
8-7-69

PIT AND DISTURBED
AREA (SEE IHSS 115)
8-7-69

133.2
ASH PITS

POSSIBLE
COVERED TRENCH ?
1969

WEST END OF
SOUTH INTERCEPTER
DITCH

DUMPED CONCRETE
7-2-55

133.6

ASH PITS ?
8-7-69

INDICATED CORRECTED
LOCATION OF 133.3
8-7-69

WOMAN CREEK

CONCRETE
WASH PAD

133.4
ASH PITS

RUBBLE PILES
10-15-64

PITS CONNECTED
BY TRENCH
10-15-64

WOMAN CREEK

FORMER
EXCAVATIONS
8-17-78

E2,079,000

SURFACE DISTURBANCE
SOUTH OF ASH PITS

RADIO RELAY
BUILDING

E2,081,000

05TM22-8.DWG

MAP LEGEND

- INTERMITTENT STREAMS DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- SURFACE WATER IMPOUNDMENTS
- 133.1 INDIVIDUAL HAZARDOUS SUBSTANCE SITES
- EXTENDED OR CORRECTED LOCATION FROM AERIAL PHOTOGRAPHS WITH PHOTOGRAPH DATE

N

0 150 300

FEET

IHSS 133.1-6, ASH PITS 1-4, INCINERATOR, CONCRETE WASH PAD, AND ADDITIONAL SURFACE DISTURBANCES SOUTH OF ASH PIT AREA WOMAN CREEK PRIORITY DRAINAGE AREA

(OPERABLE UNIT 5) TECHNICAL MEMORANDUM 2

EG&G FIGURE 2.8

Rocky Flats Plant, Golden, Colorado